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## SPECIFIC OPERATIONS CHECKLIST

### EFFICIENCY OF ELECTRIC MOTORS PROGRAM

**Instructions to the Assessor:** The checklist addresses specific accreditation criteria prescribed in Section 285.33 of the Efficiency of Electric Motors (EEM) Program Handbook. Included also are instructions and comments sheets used for observing actual demonstrations of the performance of selected test methods. These criteria supplement and **do not** supersede the *Criteria for Accreditation*, based on Section 285.33 of the NVLAP Procedures, which are addressed in the NVLAP GENERAL OPERATIONS CHECKLIST.

Place an "X" beside any of the following items which represent a deficiency. Place a "C" beside each item on which you are commenting for other reasons. Record the item number and your deficiency explanation and/or comments on the appropriate comment sheet(s). Place a check beside all other items you observed or verified at the laboratory.

#### 1 QUALITY SYSTEM

- \_\_\_\_\_ 1.1 The quality manual provides detailed procedures, including descriptions of equipment, that the laboratory follows in performing electric motor tests.
- \_\_\_\_\_ 1.2 The quality manual lists the types and sizes of electric motors that the laboratory can test under the scope of the IEEE 112 (CSA C390) standard.
- \_\_\_\_\_ 1.3 The quality manual describes practices for maintenance and calibration of the equipment used in conducting the tests on electric motors.

#### 2 PERSONNEL

The personnel competency program for Efficiency of Electric Motors Program includes the applicable portions of the following, as a minimum:

- \_\_\_\_\_ 2.1 General requirements of the electric motor test methods;
- \_\_\_\_\_ 2.2 Electric motor specimen preparation and/or mounting techniques;
- \_\_\_\_\_ 2.3 Electric motor pre-test temperature procedures;
- \_\_\_\_\_ 2.4 Techniques for measuring ambient thermal conditions; and  
Use of equipment for measuring:
- \_\_\_\_\_ 2.5 temperature,
- \_\_\_\_\_ 2.6 resistance,
- \_\_\_\_\_ 2.7 torque,



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- \_\_\_\_\_ 2.8 power, and
  - \_\_\_\_\_ 2.9 speed (rpm).

### **3 ENVIRONMENT**

- \_\_\_\_\_ 3.1 The ambient temperature is within 10 °C and 40 °C.
- \_\_\_\_\_ 3.2 The ambient temperature is relatively stable during the test.
- \_\_\_\_\_ 3.3 The motor is protected from movement of the air resulting from sources other than the motor or loading devices themselves.
- \_\_\_\_\_ 3.4 If the motor was tested at an altitude  $\geq 1000$  m (3300 ft), appropriate corrections are made.

### **4 EQUIPMENT AND REFERENCE MATERIALS**

#### **4.1 Power Supply**

- \_\_\_\_\_ 4.1.1 The power supply is at rated voltage for the motor being tested.
- \_\_\_\_\_ 4.1.2 The line voltages are balanced within 0.5%.
- \_\_\_\_\_ 4.1.3 The voltage waveform deviation factor is  $\leq 10\%$ .
- \_\_\_\_\_ 4.1.4 The average frequency is within  $\pm 0.1\%$  of the specified test value.
- \_\_\_\_\_ 4.1.5 The variation in frequency does not exceed 0.33% of the average frequency.

#### **4.2 Loading Device**

- \_\_\_\_\_ 4.2.1 The loading device, such as a dynamometer, is appropriate for the size of the motor.
- \_\_\_\_\_ 4.2.2 The friction and windage losses at the rated speed of the motor under test do not exceed 15% of the rated output of the motor.
- \_\_\_\_\_ 4.2.3 The motor is aligned correctly with the loading device (dynamometer).

#### **4.3 Thermocouples**

- \_\_\_\_\_ 4.3.1 If thermocouples are used to monitor temperature, they are installed correctly.
- \_\_\_\_\_ 4.3.2 Multiple thermocouples are cross-checked at ambient temperature for accuracy and agreement.



## 5 CALIBRATION AND TEST METHODS

### 5.1 General

Other electric motor tests may be conducted in conjunction with motor efficiency testing.

- \_\_\_\_\_ 5.1.1 The latest version of the IEEE Standard 112 (CSA C390) is available. (Note: laboratories accredited in complying with the provisions of EPACT must also have available the version of IEEE 112 that was in effect at the time of enactment of EPACT or as required by any subsequent amendment.)
- \_\_\_\_\_ 5.1.2 Electric motor specimens are properly stored, prepared, and maintained in the appropriate state before testing.
- \_\_\_\_\_ 5.1.3 Electric motor tests are performed correctly.
- \_\_\_\_\_ 5.1.4 Tests are conducted within the specified operating conditions.
- \_\_\_\_\_ 5.1.5 Electric motors are uniquely identified for correlation with the related test report and records.
- \_\_\_\_\_ 5.1.6 Test data forms are properly completed.
- \_\_\_\_\_ 5.1.7 Test reports are complete and accurate for the electric motor specimens.
- \_\_\_\_\_ 5.1.8 Participant staff for the test maintains a dated log book or record.
- \_\_\_\_\_ 5.1.9 Test equipment and instruments meet the test requirements and calibration conditions. Specific calibration requirements for the EEM program are:
  - in accordance with the manufacturer's recommendation;
  - the test method; or
  - as specified below, whichever results in shorter time periods between calibrations:

#### ***Apparatus/Instrumentation***

#### ***Calibration or Verification Frequency***

ammeters, voltmeters, and wattmeters	annually
CTs, PTs and shunts	every two years
data acquisition systems	annually
electronic transducers	annually
frequency meters	annually
resistance measurement equipment	annually
speed sensors	annually
temperature measurement equipment	annually
torque measurement equipment	annually



The accuracy of the test equipment is within the following limits:

\_\_\_\_\_ 5.1.10 instrumentation for measuring voltage, current, and power has an accuracy of  $\pm 0.2\%$  of full scale;

\_\_\_\_\_ 5.1.11 instrument transformers have an accuracy  $\pm 0.3\%$ ;

**[NOTE:** When the instrumentation in lines 5.1.10 and 5.1.11 are calibrated as a system, the accuracy shall be  $\pm 0.2\%$  of full scale.]

\_\_\_\_\_ 5.1.12 instrumentation used to measure speed has an accuracy within  $\pm 1$  rpm of the reading; and

\_\_\_\_\_ 5.1.13 instrumentation used to measure the output torque of the motor has an accuracy of  $\pm 0.2\%$  of full scale.

## 5.2 Heat Run

\_\_\_\_\_ 5.2.1 The initial resistance measurement is taken after the motor is exposed to the ambient temperature for a sufficient time for the windings to reach a stable reference temperature.

\_\_\_\_\_ 5.2.2 If a heat run is performed, it is performed first in the test sequence.

\_\_\_\_\_ 5.2.3 The heat run test is performed at rated load, 1.0 service factor.

\_\_\_\_\_ 5.2.4 If the motor is overloaded at the start of the test to shorten the total test time, the overload is kept under 50%.

\_\_\_\_\_ 5.2.5 The motor is operated at rated load, voltage, and frequency for a sufficient period of time for the temperatures to stabilize with not more than a  $1^\circ\text{C}$  change in temperature rise between two successive readings taken at  $\frac{1}{2}$  hour intervals.

\_\_\_\_\_ 5.2.6 At the conclusion of the test, the resistance between two phases is measured:

- within 30 seconds of shutdown for motors rated 50 hp or less,
- within 90 seconds of shutdown for motors rated 51 to 200 hp, or
- within 120 seconds of shutdown for motors rated above 200 hp.

If the time limits above are exceeded, the following procedure is followed:

When resistance is measured as a function of time after shutdown, the results are plotted and extrapolated back to the appropriate time delay to determine the resistance at shutdown.



### 5.3 Load Test

- \_\_\_\_\_ 5.3.1 The load test is performed following a heat run, or it is performed at another time and the motor temperature is adjusted by briefly operating the motor at rated load or some overload condition.
- \_\_\_\_\_ 5.3.2 The temperature of the motor winding is within 10 °C of the hottest thermosensor temperature recorded during the heat run at rated operating conditions on a machine under test or on a duplicate machine.
- \_\_\_\_\_ 5.3.3 The temperature is stable at the start of a test.
- \_\_\_\_\_ 5.3.4 The load readings are taken at four points approximately equally spaced between 25% and up to and including 100% of rated load, and two points suitably chosen above 100% but not exceeding 150% of rated load.
- \_\_\_\_\_ 5.3.5 The motor is loaded in decreasing order from the highest to the lowest load.
- \_\_\_\_\_ 5.3.6 The load is steady during the time that the data at each load are recorded.
- \_\_\_\_\_ 5.3.7 When necessary to perform the dynamometer correction test, it is done properly.
- \_\_\_\_\_ 5.3.8 The dynamometer correction test is performed after the load test is completed and the motor is near normal operating temperature.

### 5.4 No-Load Test

- \_\_\_\_\_ 5.4.1 The motor is operated at no-load until the power does not vary by more than 3% between two successive readings over a half hour time interval before starting the test.
- \_\_\_\_\_ 5.4.2 The test is begun at the highest voltage level and the voltage reduced in steps from that level to the lowest test value.
- \_\_\_\_\_ 5.4.3 The readings are taken at voltages from approximately 125% of rated voltage down to the point where further voltage reduction increases the current or the motor becomes unstable.

## 6 REPORTS

- \_\_\_\_\_ 6.1 Test reports contain sufficient information for the conditions to be reproduced at a later time if a retest is necessary.
- \_\_\_\_\_ 6.2 Test reports contain the technical information required by the EEM program (see NIST Handbook 150-10, Appendix G, *Report Illustration*).



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- \_\_\_\_\_ 6.3 In reporting the results of the motor tests to regulatory agencies, efficiency is calculated from the raw data using the procedure described in Method 1 of CSA C390.
- \_\_\_\_\_ 6.4 The correlation factor for smoothing stray-load loss is 0.90 or higher with no more than one of the six points omitted from the analysis.
- \_\_\_\_\_ 6.5 When necessary to repeat the test to obtain a correlation factor of 0.90 or higher, the source of error is investigated and corrected prior to rerunning the test.
- \_\_\_\_\_ 6.6 The laboratory has in place, with appropriate written descriptions in the quality manual, procedures and documentation for assuring the quality and validity of the electronic data transmission and their incorporation in the test reports.
- \_\_\_\_\_ 6.7 Copies of typical reports written at an adjunct facility removed from the laboratory are available at the laboratory at the time of the on-site inspection for review.
- \_\_\_\_\_ 6.8 When a test report is written at an adjunct facility, the report includes the names and addresses of both those responsible for conducting the laboratory tests and for writing the test report.

